

Raising Healthy Vegetables in the Organic Garden

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Challenges to Organic Gardening



Cascade Gardens, U.K.

- Maintaining a healthy environment for healthy plants
 - Balanced fertility
 - Balanced moisture
 - Adequate sunshine
 - Pest management
 - Weeds
 - Insect pests
 - Diseases

Organic Disease Management

- Importance of diseases varies among crops, locations
 - “Diseases are the Achilles heel of organic tomato production” Diver, Kuepper & Born 1995
- Strict rules for crop rotation, soil improvement, seed source, use of off-farm inputs
- Management requires an integrated approach

Plant Health Action Plan

- Winter:
 - What to plant
 - Choose well- adapted disease-resistant varieties
- Early spring:
 - Where to plant
 - Select site that maximizes plant health
 - Plan to rotate plant families to minimize soilborne diseases
 - Start seedlings
 - Choose healthy seeds
 - Treat seeds to eliminate pathogens
 - Manage seedlings to minimize damping-off

Plant Health Action Plan

- Spring - planting:
 - Prepare soil
 - Plant healthy seeds, transplants
- Summer:
 - Apply approved fungicides/bactericides?
 - Weed, prune, discard dead plant material, harvest
- Late summer/early fall:
 - Harvest, weed, discard dead plant material
 - Pull out and clean stakes, trellises
- Late fall/early winter:
 - Apply compost

Select Varieties to Resist Disease

- Use resistant or tolerant varieties wherever possible
- Tomato
 - “Mountain” series -resistance to early blight
 - Resistance to Fusarium wilt (1,2), Verticillium wilt, RKN, some viruses common
- Pepper
 - Bacterial leaf spot, virus and Phytophthora-resistant
- Cucurbits
 - Powdery mildew, virus resistance
- Heirloom varieties generally not highly disease resistant

Buy Seeds from Reputable Sources

- Use a reputable seed supplier
 - Seed sources: ATTRA fact sheet
<http://www.attra.org/attrapub/altseed.html>
- Certified organic? Organic? Untreated? GMO-free?

Select a Garden Site to Maximize Plant Health

- Well-drained, non-compacted soil
 - Raised beds a good solution to problem soils
- Adequate sunlight
- Good air movement
 - Promotes rapid plant drying
- Avoid walnut and butternut trees
 - Juglone kills tomatoes, potatoes, blueberry, apple, cucurbits, others
 - Maintain distance of 50-80 ft from trees
 - See OSU HYG-1148-93 (<http://ohioline.osu.edu/hyg-fact/1000/1148.html>)

Rotate Crops to Confound Pathogens

- Break the life cycles of pathogens
 - ≥ 3 yrs between crops in the same family
 - Some pathogens cause disease among multiple plant families
 - Plant families:
 - Tomato-potato-eggplant-pepper
 - Pumpkin-gourd-squash-cucumber
 - Cabbage-broccoli-brussels sprouts, turnip, radish, cauliflower etc.
 - Pea-bean
 - Onion-garlic-leek

Plant Healthy Seed

- Discard seed that appear abnormal - spots, shriveling, etc.
- Saved seeds should be stored in a cool dry place
- Consider seed treatment to eradicate seedborne pathogens

Seed Treatments

- Fermentation and/or acid treatment reduces many pathogens on seeds; however, may not be adequate
- Hot water treatment needed for internal pathogens

Water Bath Temperatures and Treatment Times

Seed	°F	Minutes
Brussels sprouts, eggplant, spinach, cabbage, tomato	122	25
Broccoli, cauliflower, cucumber*, carrot, collard, kale, kohlrabi, rutabaga, turnip	122	20
Mustard, cress, radish	122	15
Pepper	125	30
Lettuce, celery, celeriac	118	30

* Cucurbit seeds may be damaged by hot water treatment

Seed Treatment Cautions

- Use new, high quality seed
- Treat a small sample first and test for germination
- Treat close to time of planting (within weeks)
- Treat only once

Vegetable Transplants

- If purchasing
 - Ask for organically-produced seedlings
 - Ask about production practices
 - Only purchase healthy seedlings without any spots, lesions or wilting plants
- If producing your own seedlings
 - Use organic planting soil and fertilizer
 - Follow good sanitation and environmental control guidelines

Seedling Damping-off



- Organic seeds not treated with fungicides
- Damping-off may be a problem
- Take steps to minimize risk of damping-off

Producing Healthy Transplants

- To minimize risk of damping-off
 - Use new or sanitized trays and pathogen-free mixes
 - Raise seedling trays off the ground
 - Don't allow soil to get too cold or too warm
 - Don't overwater
 - Consider biocontrol, e.g. *Trichoderma*
- To minimize other diseases
 - Clean equipment; wash hands frequently
 - Limit handling of plants
 - Clean production space thoroughly
 - Exclude insects
 - Don't overwater
 - Don't smoke

In the Garden

- Sterilize plant stakes between crops
- Stake or trellis plants to keep fruit off soil
- Mulch with weed seed-free straw to reduce rainsplash, retain moisture and reduce weeds
- Prune appropriately
- Water appropriately
- Clean tools, equipment frequently
- Remove diseased plants and weeds in-season
- Destroy vines, etc. post-season

Biological Control of Diseases

- Improve soil quality
 - Reduce diseases by soilborne pathogens
 - Enhance composition of “beneficial” organisms
 - Increase soil organic matter
 - Composts
 - Animal-based
 - Plant-based
 - Cover crops

Biological Fungicides and Bactericides

- Antagonistic fungi
 - *Trichoderma* spp. (Rootshield, T-22)
 - *Gloeocladium* sp.
 - *Coniothyrium minitans* (Contans)
- Antagonistic bacteria
 - *Bacillus* spp. (Serenade Garden, others)
 - *Pseudomonas* spp.
 - *Burkholderia* sp. (Deny)

Chemical Control - Organic

- Fixed copper
 - Most copper formulations acceptable
 - Bacterial disease management
 - Generally weak fungicides
 - Toxic to earthworms, blue-green algae

- Sulfurs
 - Weak fungicides
 - Powdery mildew management
- Bordeaux mixture (copper sulfate + hydrated lime)
- Plant extracts
 - *Equisetum arvense* (Biodynamics)
 - Neem oil extracts - Trilogy
- Potassium bicarbonate/horticultural oils
 - (Kaligreen)
- Hydrogen peroxide (Xerotol/Storox)

Organic-Approved Products to Manage Septoria/Early Blight in Tomatoes

Control- water to run off	66.0 ab
Humega	75.9 a
Timor	67.6 ab
StorOx	61.4 ab
Biodynamic 508- <i>Equisetum arvense</i>	59.0 ab
Kaligreen	47.9 abc
Sonata + Champion WP	45.6 abc
Serenade	44.3 abc
Timorex	44.1 abc
Trilogy	39.5 bcd
Garlic Barrier	39.4 bcd
SW-3	37.1 bcd
Sonata	37.0 bcd
StorOx alternated with Champion WP	25.0 cde
Serenade + Champion WP	21.4 cde
Champion WP	10.8 de
Bordeaux mixture	5.0 e

Organic-Approved Products to Manage Powdery Mildew in Squash

Control	96.0 a
SoilSoup Compost Tea Full strength.....	94.3 ab
SoilSoup Compost Tea 1/3 strength	89.5 ab
Armicarb 100 2.5 lb....	40.0 de
Armicarb 100 5.0 lb....	40.0 de
Sulfur.....	15.8 ef
Serenade 2 lb + Kocide 2000 2 lb	15.8 ef
Serenade 1 lb + Kocide 2000 2 lb	11.2 f

Floating Row Covers to Manage Bacterial Wilt

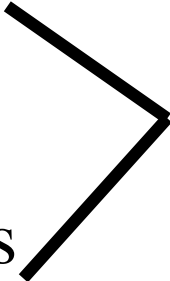


- Protects cucurbit seedlings while young from beetle feeding and transfer of wilt-causing bacteria
- Remove covers at flowering
- Beetles more attracted to flowers than stems, leaves; less of a problem for transmission of bacterial wilt pathogen

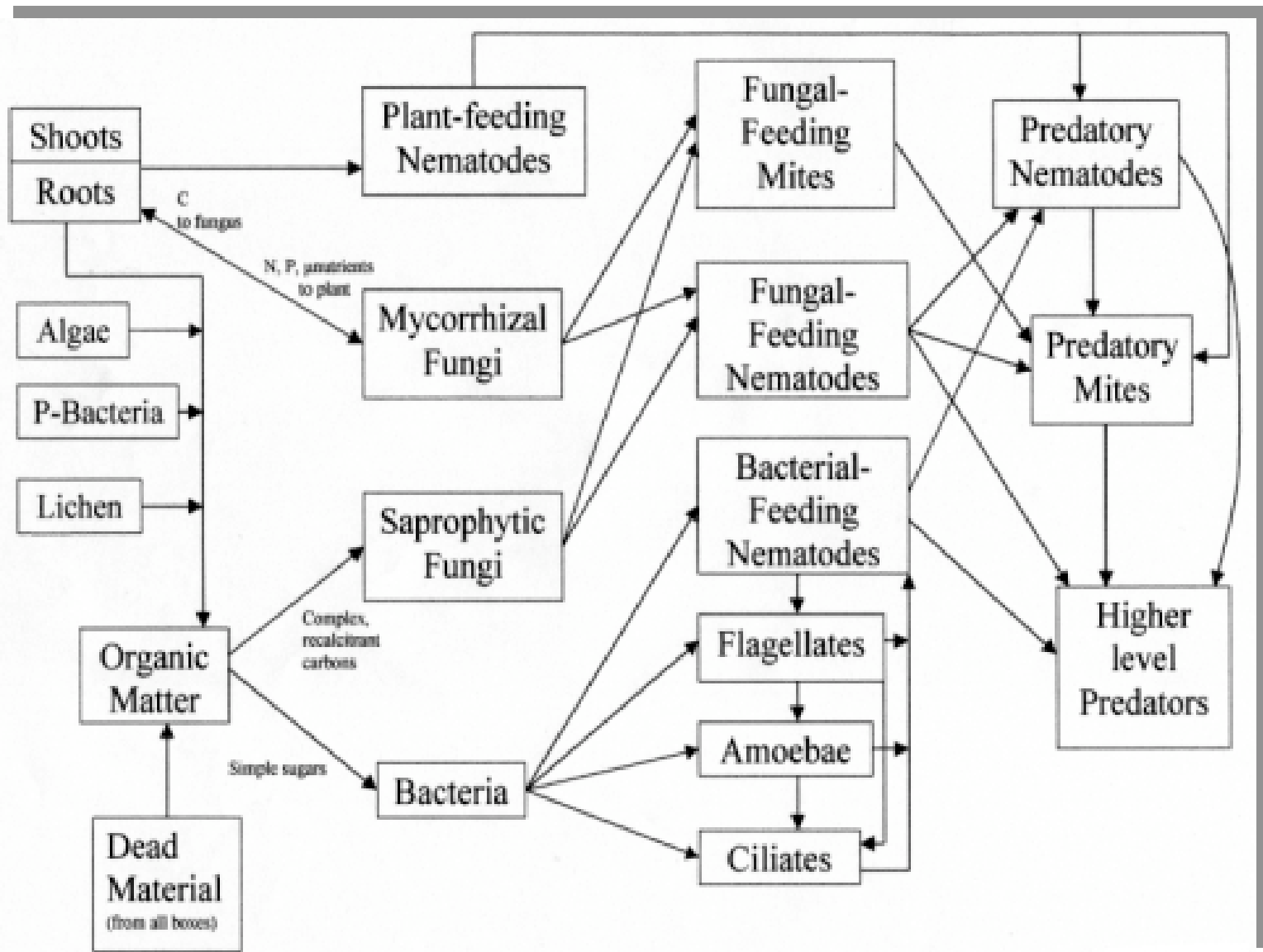
Compost Extracts and Teas

- Compost watery extracts
 - Compost suspended in a barrel 1-2 weeks
 - Supplies soluble nutrients/liquid fertilizer
- Compost teas
 - Compost extracts brewed with a food source for microbes
 - Aerated or non-aerated
- Disease suppression related to presence of microorganisms (and other components?)

Components of Compost Teas

- Soluble nutrients
 - Humic substances
 - Bacteria
 - Fungi
 - Nematodes
 - Protozoa
 - Microbial by-products
 - Particulate organic matter
 - Phyto-active chemicals
- 
- Maximize abundance and diversity
of food web contributors*

The Soil Food Web: Microorganisms



Compost Extracts/Teas and Plant Health

- Improved root growth
- Soil food web effects - soil flora and fauna
- Biocontrol of plant pathogens
 - Enhanced microbial diversity/abundance
 - Competition with plant pathogens for nutrients
 - Competition with plant pathogens for infection sites
 - Antibiosis
 - Hyperparasitism
 - Induced resistance

Compost Teas: *To Add or Not to Add a Microbial Food Source*

- Added sugar-based nutrients (e.g. molasses)
 - Sugars enhance growth of “bad guys”
 - Human pathogens
 - Plant pathogens
 - Residual sugars may remain in product that allow growth of harmful microbes
 - Plant pathogens (e.g. *Pythium*)
 - Human pathogens
- Non-sugar-based nutrients may enhance disease suppressiveness (kelp, humic acids etc) without enhance growth of “bad guys”

National Organic Standards/Related Subjects

- The National Organic Program
 - <http://www.ams.usda.gov/nop/>
- USDA links to organic-related material
 - <http://www.ams.usda.gov/nop/nop2000/nop2/fedorganlinks.htm>
- Organic Materials Review Institute
 - <http://www.omri.org/>
- National Sustainable Agriculture Information Service
 - <http://attra.ncat.org/organic.html>

Additional Information.....

- Sally Miller lab website
<http://www.oardc.ohio-state.edu/millerlab>
- ATTRA (Appropriate Technology Transfer for Rural Areas)
 - <http://www.attra.org>
- Organic Agriculture Consortium
 - <http://www.organicaginfo.org>